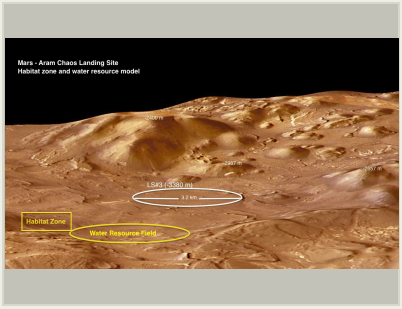
Small Business Innovation Research/Small Business Tech Transfer

Comprehensive Modeling for Off-Earth Mining Optimization and Resource Processing, Phase I

Completed Technology Project (2016 - 2017)

Project Introduction

The multi-months duration and energy constraints of the Earth — Mars journey are forcing an evolution toward the self-sufficiency of human crews in their readiness to adapt to changing circumstances and survive emergencies so far from Earth. The situation is akin to the one faced by the first waves of people brave enough to explore new continents during the course of human history. Limited by the capabilities of their ship or caravan on a long journey, their fate was inevitably tied to their ability to learn, adapt, and use their new environment and its resources as quickly as possible. The planned In Situ Resource Utilization (ISRU) can yield tangible benefits for NASA pioneering missions currently studied under the Evolvable Mars Campaign. Robotic explorations have now established the wide distribution of water in the Martian subsurface with large variations in concentrations and geological contexts (ice-rock mixtures, polyhydrated minerals). Mining and processing Martian water-bearing minerals may prove key to the ultimate success of long stays on Mars via life support and chemical synthesis of methane ascent fuel and oxygen. The prospect of exploring, developing, and exploiting mineral reserves on another planetary body evokes many technical and economic challenges, which often lead to decision paralysis in strategic planners willing to consider ISRU in deep-space missions. This Phase I work will provide NASA with a comprehensive modeling tool built to describe the processes of Off-Earth mining and materials processing in their geological context and deliver comparative technical and economic results on the optimized operations and technologies. It is a unique innovative tool built on the expertise and best practices of the terrestrial mining industry in synergy with expert space technologists in ISRU. It will provide NASA decision-makers with a means to identify and correlate major gaps in knowledge to plan technology investments and knowledge-gathering missions



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

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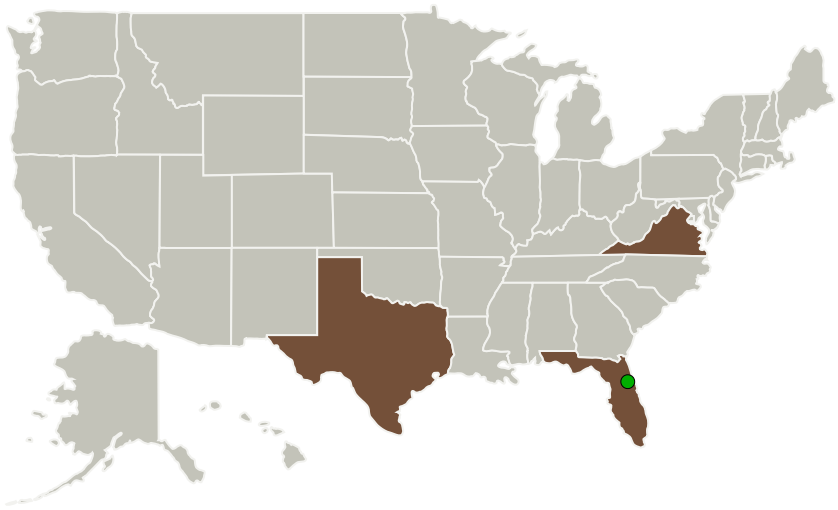
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida
Virginia Polytechnic Institute and State University(VA Tech)	Supporting Organization	Academia	Blacksburg, Virginia

Primary U.S. Work Locations	
Florida	Texas
Virginia	

Project Management

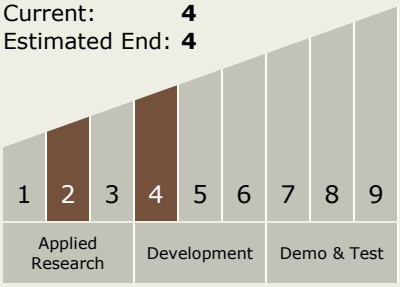
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Laurent Sibille

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.2 Resource Acquisition, Isolation, and Preparation

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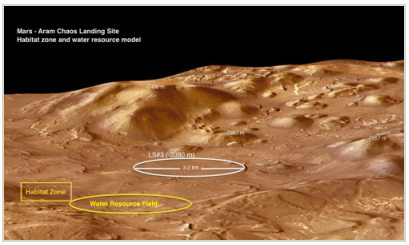
Images



Briefing Chart Image
Comprehensive Modeling for Off-Earth Mining Optimization and Resource Processing, Phase I
(https://techport.nasa.gov/image/133760)

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System